SUBJECTS AND METHODS

The aim of this study is to assess the effect of metacognitive skills training on self-directed learning readiness, critical thinking ability, and academic achievement of nursing students.

To fulfill this aim the following research objectives were formulated:

1. To identify the levels of metacognition among nursing students before and after implementation of the program.
2. To assess the levels of self-directed learning readiness among nursing students before and after implementation of the program.
3. To determine the levels of critical thinking ability among nursing students before and after implementation of the program.
4. To determine the levels of academic achievement of nursing students after implementation of the program.
5. To conduct a training program about metacognitive skills.
6. To assess the effect of the training program on self-directed learning readiness, critical thinking ability, and academic achievement of nursing students.

Research hypotheses:

1. Metacognition level of nursing students will be improved after implementing the training program.

2. Self-Directed Learning readiness level of nursing students will be improved after implementing the training program.

3. Critical thinking ability level of nursing students will be improved after implementing the training program.

4. The academic achievement of nursing students in the study group will be significantly better than those in the control group

The subjects and methods used in carrying out the study are presented under the following four main designs; technical, operational, administrative, and statistical.

Technical design:

The technical design includes the research design, setting, subjects, and tools of data collection.

Research design:

An experimental design was used to achieve the aim of the present study.

Setting:

This study was conducted at Faculty of Nursing, Zagazig University, which included eight scientific departments: Nursing administration, psychiatric and mental health nursing, medical and surgical care nursing, maternal and newborn health nursing, pediatric nursing, community health nursing, geriatric nursing and critical departement. The faculty consists of five floors as follows:

1. **The first floor** contained; one main entrance and two sided entrances, dean's office, secretary of the dean's office, waiting office for visitors, vice dean for education and students' affairs office, vice dean for research and postgraduate office, vice dean for community and environmental service office, security office, treasury, purchases office, general manager's office, secretary of general manager's office, student affairs office, class for control and exams, accounts office, general faculty member's affairs office, internship student affairs office, financial affairs office, youth welfare office, postgraduates office, evaluation unit, crisis management unit, and stock department.
2. **The second floor** involved; the faculty staff members and assistants' offices, class for celebrations and thesis discussions, scientific journal office, faculty council room, and quality management unit.
3. **The third floor** contained; class for postgraduate, three laboratories for medical and surgical care nursing, one laboratory for community health nursing and geriatric nursing, one laboratory for pediatric nursing, one laboratory for maternal and newborn health nursing, anatomical laboratory, computer science laboratory, three sections for the practical part, two classes for first and second academic years, continuing education unit,

Egyptian Novice Nurses and Students' Scientific Association (ENSSA), and student union room.

4. **The fourth floor** included; two computer laboratories, two libraries; one for undergraduate scholars and the other one for postgraduate scholars, five sections for the practical part, graduation unit, development project unit, E-learning unit, training unit, laboratory for medical surgical nursing, one laboratory for supplies and equipment, and two classes for third and fourth academic years.
5. **The fifth floor** is a large class for students' exams and practical sessions.

Subjects:

A representative sample of the fourth year nursing students who enrolled in the nursing administration course from the academic year 2021 - 2022, the total number of the nursing students were 287; the required sample size was consisted of 70 nursing students. They were divided into two equal groups; 35 study group and 35 control group.

The sample size was estimated at confidence interval 95% according to the program Epi Info version 6. **A random sampling** technique used and the sample was split into study and control group randomly.

Tools of data collection:

To fulfill the purpose of this study, four tools were used for data collection as follows:

I: Metacognitive Awareness Inventory (MAI):

The MAI is a 52-item self-reported inventory that uses a 5-point Likert-type scale, was designed and tested by **Schraw and Dennison in 1994**, consists of two parts:

Part I : Personal characteristics data sheet for nursing students to collect data about their code no, age, gender, marital status and residence.

Part II: consists of 52 statements representing two dimensions of metacognition. First dimension is knowledge of cognition, includes three sub-dimensions: declarative knowledge 7 items (knowledge about self and strategies), procedural knowledge 4 items (knowledge about how to use strategies) and conditional knowledge 6 items (knowledge about when and why to use strategies). Th second dimension is regulation of cognition, includes five sub-dimensions: planning (goal setting) 7 items, information management (organizing) 9 items, monitoring (assessment of one's learning and strategy) 8 items, debugging (strategies used to correct errors) 5 items and evaluation (analysis of performance and strategy effectiveness after a learning episode) 6 items.

Scoring system:

The responses of the items was measured by using 5–point Likert scale as follows: "Always True" (5), "Sometimes True" (4), "Neutral" (3), "Sometimes False" (2), and "Always False" (1). Scores are ranging between 52 and 260. The total score was calculated and converted into percent score by dividing students total score by the maximum possible score then multiply by 100. In this study, metacognition levels were considered;

- Low if the score less than 50%**.**
- Moderate if the score 50% to less than 75%.
- High if the score 75% or more. **(reference)**

Reliability:

The Cronbach's Alpha coefficients calculated for the internal consistency and reliability of the scale were 0.923. The Cronbach's Alpha coefficient was calculated for each sub-dimension in order to test the reliability of the measurements in the present study, which was found to be 0.891 for the sub-dimension of “Declarative Knowledge”, 0.796 for the sub-dimension of “Procedural Knowledge", 0.797 for the sub-dimension of "Conditional Knowledge", 0.882 for the sub-dimension of "Planning", 0.888 for the sub-dimension of "Monitoring", 0.839 for the sub-dimension of "Evaluatinon", 0.851 for the sub-dimension of "Debugging", and 0.881 for the sub-dimension of "Information management ". **Nunally (1978)** emphasizes that the coefficient for the reliability measurement needs to be over 0.70. **Tezbaşaran (1997)** states that a reliability coefficient that can be considered to be adequate for a Likert-type scale should be as close to l as possible. Based on the reliability coefficients obtained, the scale can be said to be a reliable measurement tool.

Sub-dimension	**Cronbach's alpha coefficients**
• Declarative Knowledge	0.891
• Procedural Knowledge	0.796
• Conditional Knowledge	0.797
• Planning	0.882
• Information management	0.881
• Monitoring	0.888
• Debugging	0.850
• Evaluation	0.839
The scale	**0.923**

Tool II: Self-Directed Learning Readiness Scale (SDLRS):

Developed by **Fisher, King and Tague (2001),** to assess the levels of self-directed learning readiness among nursing students, consists of 40 items grouped under three domains namely; self-management, motivation to learn, and self-control skills.

Scoring system:

The responses of the items was measured by using 5–point Likert scale as follows: strongly disagree (1), disagree (2), undecided (3), and agree (4) and strongly agree (5). The total score of the scale was ranged from 40 - 200. The total score was calculated and converted into percent score by dividing nursing students total score by the maximum possible score then multiply by 100. In this study, total score greater than 75% indicates for readiness for SDL **(Fisher, King and Tague, 2001).**

Reliability:

The Cronbach's Alpha coefficients calculated for the internal consistency and reliability of the scale were 0.953. Cronbach's Alpha coefficient is 0.880 for the sub-dimension of “Self-management", 0.889 for the sub-dimension of "Desire for learning" and 0.908 for the sub-dimension of “Self-control".

Sub-dimensions	**Cronbach's alpha coefficients**
• Self-management	0.880
• Desire for learning	0.889
• Self-control	0.908
The scale	**0.953**

Tool III- California Critical Thinking Disposition Inventory (CCTDI):

Developed by **Facione et al. (1991)**, to assess level of critical thinking skills among nursing students, consists of 34 multiple choice questions grouped into five critical thinking cognitive skills domains as follows: analysis, inference, evaluation, deductive reasoning and inductive reasoning.

Scoring system:

Questions were scored as one for correct answer and zero for incorrect answer, the total score was calculated and converted into percent score by dividing nursing students total score by the maximum possible score then multiply by 100. In this study,the result classified into three categories as the following:

- Weak < 35.3%
- Moderate 35.4 – 53
- Strong < 53

Reliability:

The Cronbach's Alpha coefficients calculated for the internal consistency and reliability of the scale were 0.892.

- **Modified inventory of the California critical thinking disposition sheet**:

Developed by **Facione et al. (1994)**. It was used to assess critical thinking dispositions skills, consisted of 75 items grouped into seven dispositional characteristics: truth seeking (12 items), open-mindedness (12 items), analyticity (11 items), systematic (11 items), self -

confidence (9 items), inquisitiveness (10 items) and cognitive maturity (10 items).

Scoring system:

The responses of the items was measured by using 5–point Likert scale as follows: strongly disagree (1), disagree (2), undecided (3), agree (4) and strongly agree (5). The total score of the scale was ranged from 75 – 375. Nursing students were classified on critical thinking disposition scale into three groups according to their score as follow:

- ☐ Score < 50 % (Less than 187.5) indicating negatively disposed.
- ☐ Between 50% to 66. 6% (187.5 – 249.75) indicating ambivalently disposed.
- ☐ Score > 66.6% (More than 249.75) indicating positively disposed.

Tool IV: Student transcripts:

It is the form that shows the academic achievements of the students during the term and on which the student's academic achievement is calculated. Then, students' achievement in the exam scored according to the scoring system at the faculty of Nursing, Zagazig University as follows:

- Less than 60% is poor degree.
- The range from 60% to less than 65% is pass degree.

- The range from 65% to less than 75% is good degree.
- The range from 75% to less than 85% is very good degree.
- The range from 85% to 100% is excellent degree.

Metacognitive skills training:

The metacognitive skills training has been developed for the fourth year nursing students who **enrolled in the nursing administration course**. The objective of the metacognitive skills training was to enhance self directed learning readiness and critical thinking ability among nursing students that influence on their achievement score.

Field work:

Study group

The field work for study group involved three phases namely; pre-training preparation phase, training phase, evaluation phase.

Pre-training preparation phase:

During the pre-training preparation phase; assigned readings and program development occurred. It began with reviewing the theoretical and empirical literature of national and international resources concerning the topic of the study using textbooks, articles, magazines, research, and internet search in order to get a clear picture of all aspects related to the study. Then the objectives of the metacognitive skills training were stated and the content was designed. Accordingly, the data collection tools adopted from the original authors.

Training phase:

During the training phase; group formation and information about metacognition, skills and strategies occurred.

a- **Group formation**: At the beginning of the semester, the researcher assigned nursing students randomly into two main groups as it was difficult to take the whole number of the nursing students at the same time in the same scenario. The first group consisted of 17 students and the second group consisted of 18 students. Students remained in these groups for the duration of the course.

b- **Information about metacognition, skills and strategies:** At the beginning of metacognition training phase, the researcher gave nursing students in each group an introduction about metacognition in two sessions to cover many concepts about metacognition training such as: definition of metacognition, importance of metacognition, components of metacognition, skills of metacognition, strategies of metacognition, implementing of metacognition in the nursing course, the student role in metacognition, the faculty member role in metacognition, the faculty role in metacognition and the relashion between metacognition and sels directed learning and critical thinking and how to apply metacognition skills and strategies in the nursing course.

Evaluation phase

The evaluation phase focused on assessing nursing students' self directed laerning and critical thinking levels related to their metacognitive skills training. This evaluation was applied one time for study group immediately after the completion of the training program. Additionally, assessing students' achievement scores regarding the administration course for both groups at the end of the semester.

II- Operational Design:

This design included preparation of the tools, validity, reliability, pilot study and implementation methods of data collection.

A. Validity:

The tools of data collection were tested for their content and face validity sheet by a jury of five experts from which three assistant professors and 2 professors of nursing administration at the faculty of nursing, Zagazig University. The face and content validity sheet involved two parts. The first part: Included the opinions of the experts for each item that were recorded on a two point scale: Relevant, and not relevant. The second part:

Covered general or overall opinion about the form which expressed their opinions and comments on the tools for clarity, applicability, comprehensiveness, understanding, any suggestions for any additional or omissions of items and ease of implementation. According to their opinions all recommended modifications were performed by the researcher.

B. Reliability of data collection tools:

The reliability of Metacognitive Awareness Inventory, Self Directed Learning Readiness Scale and California Critical Thinking Disposition Inventory previously were tested by the original author using Cronbach's alpha as follows: 0.923, 0.953 and 0.892.

C. Pilot study:

A pilot study was carried out with 10% of the study sample (4) nursing students to test the tools feasibility, understandability and to estimate the time consumed for filling in the forms. A brief explanation of the purpose of the study was provided to every participant in the pilot study, and then they were provided with a copy of the study tools. The time consumed in answering the questions was about 20- 30 minutes for each tool. Data collected from the pilot study was reviewed and no modifications to items of the tools so the nursing students included in the main study sample.

D. Methods of data collection:

It was necessary for the researcher to introduce herself and explain the purpose of the study for nursing students included in the study. After an explanation of the study, the data collection tools were answered by nursing students in clinical setting in which they received training in Faculty of Nursing, Zagazig University. The researcher was present at all the time for any clarification. Data collection was carried out during the period from the mid of March 2022 to the mid of May 2022. The researcher taught the metacognitive skills training in their clinical setting. Two days per week (Sunday & Tuesday). Four weeks were needed for completing the metacognitive skills training for each group of nursing students, the weeks are distributed alternately for both group so the 1st week for first group and the 2nd week for the second group and so on. As well as eight weeks were used for providing the metacognitive skills training for the two groups.

III. Administrative Design:

Before starting any step in the study, an official permissions were obtained from the dean of the Faculty of Nursing, Zagazig University to conduct the study.

Ethical Considerations:

The study was approved by the Ethics Research Committee at the Faculty of Nursing; Zagazig University. The verbal explanation of the nature, purpose, and benefits of the study was performed by the researcher to nursing students included in the study sample. Oral and written consent were taken from subjects and reassured them about the confidentiality and anonymity of the study. They were informed about their right to refuse or withdraw from the study at any time without giving a reason.

IV. Statistical Design

All data were collected, tabulated and statistically analyzed using SPSS 20.0 for windows (SPSS Inc., Chicago, IL, USA, 2011) Quantitative data were expressed as the mean ± SD & range, and qualitative data were expressed as absolute frequencies (number)& relative frequencies (percentage). Independent samples student's t-test was used to compare between two groups of normally distributed variables. Percent of categorical variables were compared using Chi-square test or Fisher exact test when appropriate. Pearson correlation coefficient was calculated to assess relationship between various study variables, (+) sign indicate direct correlation & (-) sign indicate inverse correlation. Also, values near to 1 indicate strong correlation & values near 0 indicate weak correlation. All tests were two sided. P-value < 0.05 was considered statistically significant (S), P-value < 0.001 was considered highly statistically significant (HS), and p-value ≥ 0.05 was considered statistically insignificant (NS).